NOTES ON THE BEHAVIOR OF *DINEUTES AMERICANUS*

By Howard B. Smith,

Los Angeles, California.

A study of *Dineutes americanus* carried on in the vicinity of Boston, Mass. during the past two years has led to some interesting results which are briefly presented in the present note. Recent papers ('23, Wilson, C. B.; '25, Hatch, M. H.) have dealt with the life history and ecology of this beetle and the following observations serve to clear up certain points not included in the accounts of these authors. Among the several families of water-beetles, the Gyrinidæ show more peculiar adaptations in structure and, consequently, in behavior and mode of life.

Movement:—These beetles swim by means of the meso- and metathoracic legs, which are so modified as to be almost useless for land locomotion. While on the water *D. americanus* exhibits perfect mobility and ease in swimming, on land it turns to an awkward crawl, pulling itself along by the long forelegs, tilting from side to side as the heavy unsupported body is dragged across the uneven ground. Usually, however, when off the water surface, the body is supported only by the front legs.

When about to swim the beetle extends the middle and hind legs laterally, like a pair of oars They are then brought smartly down to the caudal axis, which is their usual position at rest. The forelegs are fitted into the grooves in the sternal plate adapted to receive them or they may be extended on the surface film. Sometimes they are used for cleaning the body or to assist in the process of feeding. Because of the grooves in the sterna the legs can be withdrawn and the body then presents a perfect "streamline" form. When alarmed the insect dives rapidly, carrying a small silvery bubble at the abdominal tip.

Several experiments were undertaken to test the ability of *Dineutes* to swim in media other than water. A beetle was placed on the surface of 50% alcohol. It could not remain on

the surface, but swam about on the bottom of the dish showing great energy and no loss of faculties during the minute it was in the liquid. On being removed to the surface of water it at once overturned and swam about belly-upward. When righted it swam deeply, keeping the head under water. It was then placed on a raft from which it dragged off with some difficulty and remained quietly on the water. The legs were not apparently capable of successful movement and at the end of five minutes the body was relaxed and the beetle died without any indication of activity. The experiment was repeated with weaker solutions as shown in the table. With the denser liquids, the ability to keep afloat was perceptibly greater but in no case was it entirely satisfactory due to the decrease in surface tension.

% Alcohol	Length of Life	% of time submerged during one minute
50	5 minutes	total
25	2 "	total
10	30 "	97
5	60 "	92
4	undetermined	89

The lighter specific gravity of the medium in combination with the fact that the alcohol serves to wet parts of the body that are normally dry causes the difficulty in keeping afloat. As these insects are easily drowned, death was probably from that cause rather than from alcoholic poisoning.

A salt solution of the density of seawater (1.026) was also used. There was no apparent t ouble in swimming but the diving speed was very much slowed down. The beetle did not object to the solution but finally crawled up the dish and escaped to the table.

During the fall of 1924 and the spring of 1925 a close watch was kept on several ponds in the vicinity for indications of the winter habits of this insect. One pond was especially scrutinized because of its greater population during the summer months.

The peak of the population had been reached during the third week in August when the pond was literally covered with *D. americanus*, together with a few specimens of another species, *D. hornii*. They remained on the deeper parts of the pond in schools well away from the bank, where they were moderately active and not easily alarmed. As the season advanced they split into more or less compact groups which spent more and more of their time near the shore. On October 4, there were two groups remaining. One, including a few individuals, drifted about the outlet; the other, a larger group, gathered on a shallow spot about a stump on the western edge. At this time there were a few specimens of *Gyrinus* scattered about also but on October eighteenth no beetles were visible. A week later two individuals were found widely separated. On November first, no insect life was visible about the pond except a few black flies. After the ice had formed beetles were found in the mud but none were resuscitated.

The first appearance of *D. americanus* in the spring of 1925 was during the latter part of April, several weeks after the first signs of insect activity. As may be seen from the accompanying table, it is evident that *Dineutes* leaves hibernation somewhat later than the Hemipterous back-swimmer of the genus *Notonecta*.

Date	Air	Water	Mud	Prec.	Weather	Time
March 28	11°C	12½°C	11°C	0.18	Showers	2 p. m.
April 3	14¾°C	10°C	9°C	0	thin clouds	1 p.m.
One water strider and six back-swimmers observed.						
April 11	11 C	12 C	10 C	0	Bright	2:30 p.m.
Back swimmers abundant						
April 23	19°C	16°C	12°C	0	Bright	12 m
D. americanus first observed.						

It will be readily seen from these data that the temperature of both mud and water determine the date of appearance. A few days later, April 25, *Dineutes* was active on several other ponds nearby in considerable numbers.

At the time of their appearance the beetles were extremely active and copulation took place quite frequently. Previous to mating the beetles swim along apparently without interest. The male then makes a dash for the female and, if successful, rides on her back holding on with his fore tarsi which are placed at the juncture of the elytra and thorax. They swim thus for several minutes, or more exactly the period varied as observed from one to twelve minutes.

The population reached a peak in the first week in June up to which time the beetles had spent their time near shore. During

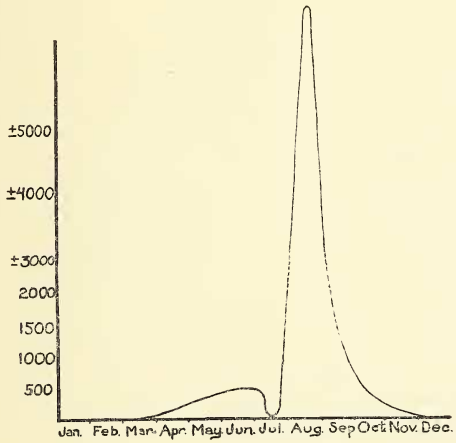

Fig. 1. Seasonal abundance of *Dineutes americanus* at Boston, Mass.

the month the population decreased rapidly until at times it was rather hard to find specimens. The curve resumed an upward trend about the first of August and within ten days, thousands were present. No copulation among these was noticed and the insects preferred to lie quietly in the sunshine, or swim slowly about on the deeper water. They are not easily alarmed and not so readily disturbed by noise or movement as in the spring. The following figure, based on careful estimates represents the fluctuations of populations as observed for five years.

From this curve and data I conclude that there is but one brood a year. The adult beetles emerge during the first few days in August, remain quiet and inactive until forced by closing waters to go into the mud for the winter. The survivors, few in number, emerge in April and, after breeding, soon begin to die out and disappear.

From observations made in a large concrete tank it is evident that there is a high mortality during the winter. The above statement is further shown to be probable by the death just after copulating on May 9, 1925, of the two surviving members of a colony which had been kept in a tank in a greenhouse during the winter.

When first brought from the pond the beetles are greatly disturbed and try to get out of the dish by swimming and later attempt to climb the sides of the dish. At times they rustle their wing covers thus producing a buzz. They become accustomed to captivity after a while and finally are not alarmed even by quick movements of the hands in their close vicinity. At this stage they can be induced to feed from the fingers. I found few things they would not attempt to eat as anything that floated was eagerly seized and examined. Live mealy bugs, cracker crumbs, bits of salmon and sardines, bread crumbs, apple parings, meat and chocolate were all sampled besides many other materials. The only requirement seemed that of ability to float. The prepared fish food known as "Ant Eggs" composed mainly of ant pupæ made a good food and a ground meat scrap containing no bone, put up by the Quaker Oats Company for poultry feed, was also successful. As long as this food remained on the surface the insects would rush about grabbing piece after piece. Sometimes two would snatch the same piece or one would attempt to take a portion from another. At such times they would dive and tear about under water until one lost its hold.

The front legs are always used to hold and turn the food about. Sometimes the beetles would attach themseleves to my hand as I dipped it into the water. On such occasions the first was sure to be followed by others all pushing and striving to get at the particular place its neighbor occupied. They never were able to pierce the skin, although their attemps produced a tem-

porary irritating sensation. Some individuals eat more than others.

A darkened battery jar was used in studying the reaction of these insects to light. If some practicable scheme can be devised for covering the beetles eyes, better results will be obtained. I found that adhesives interfere with the insect for it usually spent its time trying to rub off the coverings, often with success.

In the darkened tank the beetles remained quiet but when light was admitted at the surface through a small hole in the varnish activity ensued. The beetles swam about and tried to get out but showed neither positive nor negative phototropism so far as could be observed. Light was then admitted in a beam six inches below the surface. The beetles left the surface and dived to the point at which the light was admitted. This latter behavior was also noticed when the light was admitted only through the lower opening. From this it is reasonable to believe that a stimulation of the lower eyes results in a positive phototropic response, while the upper pair do not show either form of phototropic response with sufficient regularity to be determined.

A statement concerning the water line of the beetle seems desirable. Hatch ('25) speaks in detail of the "stream-lines" of the body and of its position on the water. He failed to notice that the shadow cast on the floor of the tank by the beetle is not a continuous ellipse in conformity with the shape of the body but that, owing to the breaking of the surface film by the swimming legs, the shadow really consists of two circles which indicates that the body of the beetle is wet only at the point where the swimming legs enter the water.

References.

Wilson, Charles B.

'23 Waterbeetles in Relation to Pondfish Culture, with Life-histories of those found in Fishponds of Fairport, Iowa. Bull. Bur. Fisheries, Vol. XXXIX, pp. 231-345, figs. 148.

Hatch, Melville H.

'25 An Outline of the Ecology of Gyrinidæ. Bull. Brooklyn Ent. Soc., Vol. XX, pp. 101-114.